

Lesson Plan

Solid Waste

Grade Level

- 3-7, can be easily adapted for older grades

Main Ideas

- 80% of generated waste is taken to an underground garbage dump known as a landfill.
- There are different types of landfills depending on the type of waste created, but most household trash is taken to a Municipal Solid Waste Landfill.
- Landfills have many rules and regulations and must be monitored by men and women that work for IDEM.
- Construction of a landfill is a complicated process that involves compliance with regulated standards and the cooperation of many people.

Objectives

To teach students about solid waste and landfills using a combination of information, demonstrations, and a fun food activity.

Materials Needed

- Pre-made "Garbage pizza"
- 1 pre-made pie crust per 10 students
- 4 pudding cups per 10 students
- 1 bottle of chocolate syrup
- 1 bag of licorice twists
- 1 bag of Tootsie Rolls®
- 1 bag of M&Ms®
- 1 bag of Oreo® cookies
- 1 container of green sprinkles

In this lesson...

- [Teacher Preparation](#)
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- [Lesson & Activities](#)
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- [Indiana State Science Standards Covered in this Presentation \(3-7\)](#)
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Teacher Preparation

For use when a teacher is giving the presentation on his or her own

Overview

This presentation is designed to help students better understand where their trash actually goes when it is taken away. It also explains how landfills are regulated and constructed.

Materials Needed

The following items should be gathered before beginning the presentation:

- 1 pre-made pie crust per 10 students
- 4 pudding cups per 10 students
- 1 bottle of chocolate syrup
- 1 bag of licorice twists
- 1 bag of Tootsie Rolls®
- 1 bag of M&Ms®
- 1 bag of Oreo® cookies
- 1 container of green sprinkles

Additional Resources

Check out the "[Taking it further](#)" section for another activity that can help you integrate this presentation into a larger lesson plan or thematic unit, follow-up the presentation with more activities, or simply give you ideas for future lesson plans.

The [Indiana State Science Standards](#) covered in this program have also been provided for you, allowing you to cover the standards with an environmental twist. Further, a [glossary of terms](#) covered in the presentation is provided to help students retain the information learned during the presentation.

Presenter Preparation

For IDEM staff members giving the presentation

Overview

This presentation is designed to help students better understand where their trash actually goes when it is taken away. It also explains how landfills are regulated and constructed.

Materials Needed

You should prepare the materials you are to bring prior to your presentation. Contact Chad Trinkle at (317) 233-9479 with any questions you may have regarding where to find them or how to use them.

- [Landfill Construction](#) overheads
- [Additional overheads](#), as needed
- "Garbage pizza"

Remind the teacher you are presenting for to prepare his or her materials ahead of time and to purchase the ingredients for the edible landfill activity.

Presentation Tips

- Read through the presentation beforehand to become comfortable with the information presented and to identify any alterations you want to make.
- The outlined presentation is merely a rough guideline. You are not expected to get through all the information available; feel free to pick and choose which parts to present based on time constrictions, your personal preferences, and age of your audience.
- Younger audiences are more likely to get restless, so be sure to keep them entertained.
- Provide positive feedback to your students as you go. Be sure to smile at them and encourage them to participate.
- Instructor enthusiasm is contagious. Have fun!

Lesson & Activities

A. Introduction

When a person says that the garbage truck took the garbage away just think, where really is "AWAY?" Does it disappear, or do we put it somewhere?

Out of 100% total garbage waste, only 20% is either incinerated (burned), composted (made into material that is used to enrich the soil), or recycled (made into other usable material). This is a combined percentage. The other 80% of generated waste is put into landfills.

Activity # 1¹

Garbage Pizza

A demonstration for the entire class.

Purpose: To show students what's in a landfill using percentages, math, and fun props

Materials: Pre-made "Garbage pizza", Waste Category Percentage Sheet: "[What's in Our Trash?](#)"

Instructions:

Ask the students to think about what makes up our garbage while revealing to them the categories of trash that are most common (glass, metal, hazardous waste, etc.). Have them rank the materials from most to least abundant and then reveal to them the true percentages using the pre-cut pizza pieces that correspond.

Discussion/ Follow-up: Discuss with these students how the actual percentages compare to what they had guessed. Also be sure to note how much of the waste stream is recyclable.

B. Solid Waste Landfills

After our trash is taken away, it is driven to a landfill or a waste transfer station.

A landfill is an underground garbage dump for which specific rules and regulations are written.

There are two main types of landfills. One type is called a solid waste landfill. Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, or air pollution control facilities, and other discarded materials.

Some examples of solid waste that go into a typical municipal landfill are paper, yard waste (trimmings, leaves, etc.), metals, food, glass, wood, plastics, and other miscellaneous items. Biodegradable materials may decompose over many years, while non-degradable materials, such as glass and most plastics, remain at the site.

C. Hazardous Waste Disposal

The second main landfill type is for Hazardous Wastes.

Hazardous Waste is any type of solid, liquid, or gas that is harmful to the environment or to humans. Most hazardous waste comes from manufacturers who use chemicals to create their products. This leftover material can be hazardous and must be disposed of in a proper manner. Only specifically designed and permitted landfills may take Hazardous Waste, as it can be toxic, corrosive, or explosive.

¹ Adapted from Lake County SWMD Environmental Recipe Book.

D. Environmental Monitoring/Regulating and Career opportunities

The two main tools that IDEM uses to safeguard the public from improper waste disposal are permitting and inspecting landfills.

Before IDEM will allow (give a permit) someone to build a landfill there are many different things that must be checked out by IDEM's technical experts and scientists. First of all, the landfill operators must be trained and certified so they may begin using their landfill. Secondly, the landfill must be constructed correctly. Finally, once the landfill is in place and begins to function, IDEM then has to inspect it to make sure that it is being run properly.

Many people who work at IDEM have jobs related to this. A few of them are as follows:

1. Permit Writer/Manager – Review landfill applications for correct information and try to gather all of the information the State needs to make its decision on the siting of the landfill. They get information from IDEM staff who read the application, talk to the person who wants to build the landfill, talk to neighbors who live close to the landfill site and hold a public hearing. Then, the permit manager writes the permit from all the information that was gathered. Sometimes permit managers have to go to court to tell the judge how they made their decision. Permit managers talk to a lot of people about the landfill to help them make the decision about the proper and protective construction of the landfill, they write up the decision and then they help explain the decision in the form of a permit.

2. Geologist – Look at the ground where the landfill is to be placed to make sure the landfill is constructed in such a way that the lakes and streams and underground water are protected. Since landfills are built like giant ziploc bags and we don't want them to leak, landfill operators must install monitoring wells around the landfill to check if it is leaking. Geologists review the installation of monitoring wells for proper placement and construction to be sure that contaminants are not leaking from the landfill.

3. Engineer – Review the plans to build a landfill (construction designs) to make sure that rules are followed such as having proper liners installed with the proper type and thickness and leachate (drainage liquid) collection system design so that waste materials cannot escape and possibly leak into groundwater or streams.

4. Chemist – Help review the permits for landfills. They look at test results of the wastes to see what is going into the landfill. They look at test results of the groundwater underneath the landfill to see if anything is leaking from the landfill and contaminating the groundwater. Chemists look at if the samples are taken correctly, they look to see if the laboratory tested the samples correctly, and then they help interpret the results to make sure that the landfill is operating correctly.

5. Inspector – Make sure that the rules are being obeyed and the landfill is operating properly. Some of the things that inspectors look for are:

- Are the right wastes (allowable) being placed into the landfill? (Different wastes are placed into different types of landfills)
- Are only solids being placed in the landfill? (Liquids should not be placed into landfills.)
- Are wastes being managed properly, covered, not blowing around, etc.? (This will keep down the rodent, insect and bird problems at the landfill)
- Is the liner being installed properly? (As the landfill is used, it is divided into cells and each cell is lined and sealed.)
- Are the filled areas of the landfill closed and covered with clay and soil and is that cover vegetated to prevent erosion?
- Is access to the site being controlled?
- Are the wells around the landfill being tested to check if the landfill is leaking into the ground and groundwater?
- Checking compliance with specific permit issues.

E. Construction of a Landfill

Note: Use [handouts/transparencies on landfill construction](#)

As you can see, many people are involved in the process of correctly constructing a solid waste landfill. This is because from bottom to top, there are many steps involved in creating a working landfill.

You can think of a landfill's design as a big sandwich, with lots of layers.

- **Solid Waste Landfills** - Starting from the bottom, 3 feet of clay and a plastic liner (in combination are called a composite liner) are used to reduce seepage of contaminated fluids (leachate) into the soil and groundwater. Next you will find the leachate collection pipes that collect liquids from the garbage in the landfill. Then 12 inches of sand or gravel is added so that the leachate can drain into the pipes. After this, a first layer of 8-10 foot deep compacted garbage is added, and at the end of each day, 6 inches of soil, shredded tires, compost, sludge, or wood chips is added to prevent the landfill from giving off really bad odors. More soil is added between each additional layer of garbage until the landfill becomes full. Once the landfill is full, the top must be covered with a 12 inch drainage layer to vent off the methane gas that is naturally produced through the decomposition of garbage. Next, 24 inches of soil is added, and then a plastic liner is placed on top to cap it off. Then another 12 inches of gravel or sand is added (this is to allow water to drain through). And then a final 24 inches of a protective layer, which consists of soil and vegetation (grass, etc.).
- **Hazardous Waste Landfills** - The basic structure is similar to that of a solid waste landfill, but varies slightly due to the nature of waste disposed of. For instance, all hazardous waste landfills are constructed using double liners (clay and flexible membrane). They also have liquid management systems including leachate collection and removal, leak detection, and surface water collection systems. It is also very important that hazardous waste landfills have extremely strong closure systems after they are full, including flexible membrane caps, gas control, and more.

Activity # 2²

Edible Landfill

An activity for the entire class

Purpose: To teach students about the composition of a typical landfill by making an edible model

Materials:

- 1 pre-made pie crust per 10 students
- 4 pudding cups per 10 students
- 1 bottle of chocolate syrup
- 1 bag of licorice twists
- 1 bag of Tootsie Rolls®
- 1 bag of M&Ms®
- 1 bag of Oreo® cookies
- 1 container of green sprinkles

Instructions:

1. The pie shell represents the clay-lined hole that begins the process.
2. To protect the groundwater, the clay is lined with plastic. Have students cover the crust with chocolate syrup or topping to represent plastic.
3. Explain that the leachate ("garbage juice" produced from rain and moisture percolating through in the landfill) accumulates at the bottom of the hole, but can't get through the plastic and clay. Therefore, pipes are placed at the bottom to collect and pump leachate to the surface where it is handled as a Hazardous Waste. Have students place licorice twists horizontally along the bottom to represent the pipes.
4. Next, explain to students how decomposing garbage produces methane gas, which must be collected or burned to prevent air pollution and possible explosions. Pipes are placed throughout the landfill to vent the methane to the surface where it can be collected. Set Tootsie Rolls vertically throughout the piecrust to represent the methane collection pipes.
5. Now have the students make the garbage! Combine the pudding with M&Ms and dump it on top of the landfill. The M&M colors usually bleed into the pudding creating a messy-looking garbage dump.
6. Now a thick layer of topsoil is placed over the garbage. Have students crunch up Oreo cookies and sprinkle crumbs on top to represent this.
7. Remind the students that once a landfill has reached its capacity for garbage, additional measures are taken to "close" the site in a safe manner. Another plastic liner (more chocolate syrup) is placed over the entire area to prevent water leaking into the site and producing excess leachate. Chocolate syrup should now cover the top of the garbage.
8. The last part of the landfill is the grass that is placed on top. Have the students put green sprinkles as "landscaping" on top.

Discussion/ Follow-up: After students have constructed their edible landfills, spoon it into bowls and eat! Discuss with them the different parts of the landfill and re-emphasize the different careers at IDEM that work closely with each part.

² Adapted from Lake County SWMD Environmental Recipe Book.

F. Conclusion: What can we do?

Everyone can help in the effort to slow the usage of our natural resources simply by becoming aware of the amount of trash being produced and making an attempt to reduce it. Waste reduction slows the depletion of natural resources and reduces pollution associated with the extraction of raw materials and the manufacture of products.

A few simple ways to go about reducing solid waste are:

- If you take your lunch to school, make it "garbage free." Take your sandwich and drink in reusable containers. Avoid using throwaway containers.
- When shopping, take cloth or string bags with you to avoid the need for paper or plastic bags. Before you buy something, notice how the product is packaged. Is all the packaging needed? Can it be reused or recycled? Choose products with little or no packaging or those that have reusable or recyclable packaging. If it will become trash, avoid it.
- Another way you can help save the Earth is through recycling. Recycling helps keep valuable resources like metal, glass, paper and plastic out of the trash. If recyclable resources are collected properly, they can be made into useful thing that we all need and want.



Taking it Further

IDEM's presentations are designed to suit both the environmental scientist with no experience in the classroom and the experienced educator who wants to give his or her students a fresh learning experience.

However, there are a few things that the trained teacher can offer that are not possible to replicate in a short presentation. This section provides that teacher with additional activities that can be used in place of or in addition to the ones in the lesson.

Additional Activity

Bioreactor Landfill

An activity for grades 6-12

Purpose: To extend the concepts introduced in the "[Edible Landfill](#)" activity into a productive activity for older children in grades 6-12

Materials: paper, writing utensil

Instructions: Once the students understand the basics about how a traditional landfill ("dry tomb" landfill) works (anaerobic decomposition, no oxygen present to allow bioreaction to occur), challenge the students to become engineers and design a "[bioreactor](#)" or "wet landfill" that utilizes aerobic bioreactions (oxygen is present) to essentially speed up the degradation of the waste.

Discussion/Follow up: Have the students present their inventions, one at a time. Have the class vote on the best design and lead discussion on what makes its design the most functional. Use the [diagram](#) of a bioreactor to explain to the class what a real design looks like.



Indiana State Science Standards Covered in this Presentation (3-7)

Third Grade

Technology and Science

3.1.8 Describe how discarded products contribute to the problem of waste disposal and that recycling can help solve this problem.

Manipulation and Observation

3.2.2 Measure and mix dry and liquid materials in prescribed amounts, following reasonable safety precautions.

Systems

3.6.1 Investigate how and describe that when parts are put together, they can do things that they could not do by themselves.

3.6.2 Investigate how and describe that something may not work if some of its parts are missing.

Models and Scale

3.6.3 Explain how a model of something is different from the real thing but can be used to learn something about the real thing.

Fourth Grade

Technology and Science

4.1.6 Explain that even a good design may fail even though steps are taken ahead of time to reduce the likelihood of failure.

4.1.8 Recognize and explain that any invention may lead to other inventions.

Communication Skills

4.2.4 Use numerical data to describe and compare objects and events.

Shapes and Symbolic Relationships

4.5.4 Demonstrate how graphical displays of numbers may make it possible to spot patterns that are not otherwise obvious, such as comparative size and trends.

Systems

4.6.1 Demonstrate that in an object consisting of many parts, the parts usually influence or interact with one another.

4.6.2 Show that something may not work as well, or at all, if a part of it is missing, broken, worn out, mismatched, or incorrectly connected.

Models and Scale

4.6.3 Recognize that and describe how changes made to a model can help predict how the real thing can be altered.

Please Note

These Indiana State Science Standards apply only to the [Lesson & Activities](#) section of this lesson plan.

They do not apply to the [Taking it Further: Additional Activities](#) section.

Fifth Grade

The scientific Enterprise

5.1.3 Explain that doing science involves many different kinds of work and engages men, women, and children of all ages and backgrounds.

Technology and Science

5.1.6 Explain how the solution to one problem, such as the use of pesticides in agriculture or the use of dumping for waste disposal, may create other problems.

5.1.7 Give examples of materials not present in nature, such as clothing, plastic, and concrete that have become available because of science and technology.

Computation and Estimation

5.2.2 Use appropriate fractions and decimals when solve problems.

Systems

5.6.1 Recognize and describe that systems contain objects as well as process that interact with each other.

Models and Scale

5.6.2 Demonstrate how geometric figures, number sequences, graphs, diagrams, sketches, number lines, maps and stories can be used to represent objects, events, and processes in the real world although such representation can never be exact in every detail.

Sixth Grade

The Scientific Enterprise

6.1.4 Give examples of employers who hire scientists, such as colleges and universities, businesses and industries, hospitals, and many government agencies.

6.1.5 Identify places where scientists work, including offices, classrooms, laboratories, farms, factories, and natural field settings ranging from space to the ocean floor.

The Earth and the Processes that Shape It

6.3.16 Explain that human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and farming intensively, have changed the capacity of the environment to support some forms of life.

Reasoning and Uncertainty

6.5.5 Explain the strengths and weaknesses of using and analogy to help describe and event, object, etc.

Seventh Grade

Technology and Science

7.1.7 Explain how engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems.

7.1.8 Explain that technologies often have drawbacks as well as benefits. Consider a technology, such as the use of pesticides, which helps some organisms but may hurt others, either deliberately or inadvertently.

7.1.9 Explain how societies influence what types of technology are developed and used in such fields as agriculture, manufacturing, sanitation, medicine, warfare, transportation, information processing, and communication.

Human Identity

7.4.14 Explain that the environment may contain dangerous levels of substances that are harmful to human beings. Understand, therefore, that the good health of individuals requires monitoring the soil, air, and water as well as taking steps to keep them safe.

Reasoning and Uncertainty

3.5.5 Explain that one way to make sense of something is to think of how it relates to something more familiar.

Models and Scale

3.6.3 Explain how a model of something is different from the real thing but can be used to learn something about the real thing.

Glossary of Solid Waste Management Terms

Clay Liner

The first layer of a landfill, used in conjunction with a plastic liner to reduce seepage of contaminated fluids into the groundwater and soil.

Hazardous Waste

Any type of waste that is or can be harmful to the environment or to humans.

Landfill

A specially engineered site where waste is buried.

Leachate

Water or moisture that has percolated through garbage.

Leachate Collection Pipes

One of the many layers of a landfill; these pipes collect leachate that gets into the landfill and sends it off to be treated.

Methane

A gas that is released during the decomposition of organic material in landfills, and is the major component (>80%) of natural gas.

Solid Waste

Garbage, construction debris, commercial refuse, and other discarded materials, that are not hazardous.

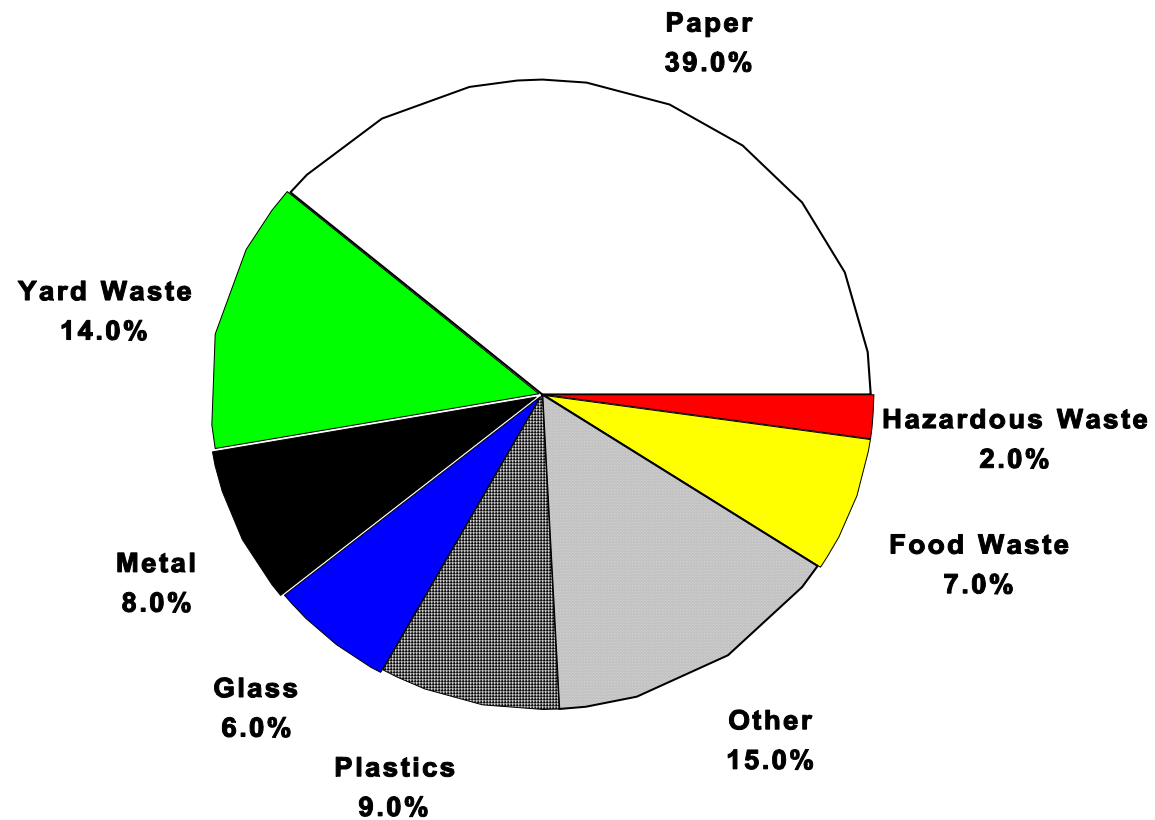
Solid Waste Reduction

The practice of reducing the amount of solid waste in residential, municipal, and industrial settings.

Additional Presentation Materials

- **What's in Our Trash?**
- **Q&A: Solid Waste**
- **Q&A: Hazardous Waste**
- **Landfill Construction overheads**
- **Diagram of a bioreactor**
- **Additional overheads / Landfill construction pictures**

What's in Our Trash



Q&A: Solid Waste

1. What happens to a landfill over time?

Some constituents are carried out of the landfill in leachate water. This leachate water is usually taken to a wastewater treatment plant. Biodegradable materials decompose over time, while non-degradable materials, such as glass and plastic, remain at the site.

2. What comes out in the water that leaches through the landfill, and how is ground water affected?

Leachate can contain a variety of substances depending upon the contents of the waste, including metals, organic compounds, suspended particles, and bacteria. If toxic wastes are deposited in the landfill, the leachate can contain toxic chemicals that are hazardous even at low levels. Many of these substances pollute ground water.

Leachate treatment depends upon specific leachate contents and can include aerating to get rid of volatile compounds and gases, as well as to enhance oxygen-dependent degradation of organics, settling or filtering to remove sediment, and other treatment to stimulate chemical or microbial degradation of contaminants. Some leachates require no treatment.

3. How is the volume of waste entering a landfill regulated?

Generally, the volume of waste accepted is set in the terms of the landfill permit, usually as tons per month. The landfill operator weighs the waste upon arrival, and tonnage reports must be submitted on a quarterly basis to IDEM.

4. How close can a landfill be to my house? And, should I grow a vegetable garden next to one?

A landfill must be at least 900 feet (approximately the length of 3 football fields) from an occupied dwelling unless written permission to be closer is given by the occupant. If the landfill is operated properly, there is no reason not to have a garden next to one. However, it would be wise to locate the garden where it would not be directly exposed to the landfill discharges -for example, not placed close to and downhill from the landfill.

5. Won't a landfill draw varmints (vectors), such as rats, flies, mosquito's, pigeons, and raccoons?

At the end of each day, a municipal solid waste landfill is required to be covered with a layer of soil to deter scavenging animals. If the cover is properly applied, these pests should be less of a problem. Note: The daily cover is applied mostly to prevent the landfill from giving off really bad odors.

6. Are hazardous wastes disposed in sanitary landfills?

Both hazardous and solid waste regulations prohibit disposal of hazardous waste in a landfill that is not specifically designed and permitted. Nevertheless, we generate a great deal of hazardous wastes in our home that we unwittingly dispose of daily. For example, pesticides and paint thinners may be tossed in trash and taken to the landfill. Most businesses are regulated and monitored for their hazardous waste disposal practices. Although some people and companies illegally put hazardous wastes in landfills, heavy penalties including fines and jail sentences make illegal disposal very unattractive. Note: Household hazardous wastes are excluded from the Hazardous Waste rules at 40 CFR 261.4(b)(1).

Q&A: Hazardous Waste

1. What is hazardous waste?

Hazardous waste can be a solid, liquid, or gas. It is a waste material that may be harmful to human beings or the environment when not handled properly. This waste material can be the by-product of a manufacturing process, or it can result from an accidental spill or release of a chemical product. Hazardous waste has certain characteristics that make it potentially harmful. It may be toxic, corrosive, ignitable, or explosive.

2. Where does it come from?

Manufacturers use many chemicals to create their products. The waste material, or what's left over when the desired item is completed, can be hazardous. The production of all sorts of things - from medicines to tennis shoes - can generate hazardous waste. Putting the colors in paints and fabrics generates hazardous waste. So does the manufacture of many metal, plastic, and even wood products.

Hazardous waste is generated by big industries like automobile and computer manufacturers and by small businesses like your neighborhood cleaners or photo shops. About 2 to 4 percent of all wastes generated in the United States are hazardous.

3. Can we stop producing hazardous waste?

No, however, we can reduce quantities through careful management. But the fact is that production of telephones, television sets, computers, cars, and countless other items that we use every day generates waste material. Some of these wastes are hazardous. While it is possible to reduce the volume of hazardous waste in manufacturing, it is not possible to eliminate hazardous waste or hazardous waste treatment residues entirely, because of our continued demand for goods. Note: IDEM manufacturing assessment helps companies find less hazardous ingredients (materials) to use in their processes (manufacturing of goods). IC 13-19-1 states that clean manufacturing is the preferred approach to environmental protection.

4. What is being done to reduce hazardous wastes?

With proper management, we can take the hazard out of hazardous waste. Better manufacturing processes and worker training are reducing quantities used and non-hazardous or less hazardous ingredients are being substituted in processes. Some wastes are refined and recycled; others are immobilized so they cannot be released into the environment. Another important way is to design well-managed, well-regulated hazardous waste management facilities with proper state permits.

5. What are some of the methods of disposing of hazardous waste? Who manages hazardous waste?

A variety of techniques exist for the safe management of hazardous waste.

- **Reduction** - Some industrial process can be changed to reduce the volume of hazardous waste.
- **Recycling** - Some hazardous wastes can be reused, either in industrial processes or as useful products.
- **Treatment** - Thermal treatment (incineration). Burning at high temperatures destroys many toxic compounds found in hazardous wastes. Chemical treatment. Certain wastes can be made less hazardous by the application of standard chemical processes. Biological treatment. This treatment employs microorganisms that consume the waste material.

- **Land disposal** - Federal and state regulations require the pretreatment of most hazardous wastes before they can be land disposed. These treated materials can only be place in specially designed land disposal facilities. Note: We do have one hazardous waste landfill in Indiana it is Heritage Environmental landfill in Putnam Co. (2 counties directly west of Marion Co.).

329 IAC 10-17-2 Overview of liner designs and criteria for selection of design

I. Design criteria for landfill units not located over an aquifer of significance (Standard Design)

or

For landfill units that are separated by at least 10 feet of non-aquifer materials ($k \leq 1 \times 10^{-5}$ cm/sec)

See Figure 1

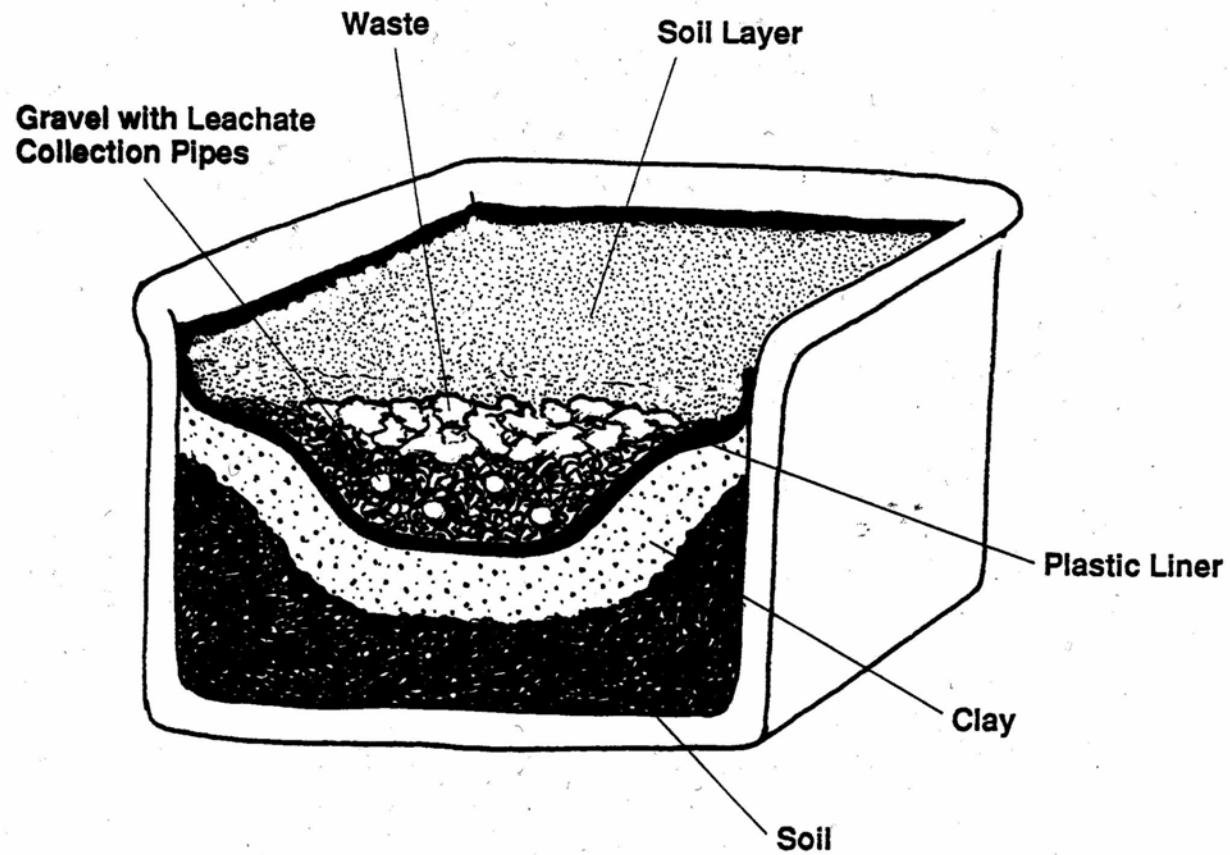
A. 10-17-2 (a)(1) At the base and side slopes, starting from the subgrade and extending upward:

- 1. 3 feet of compacted soil with hydraulic conductivity of $k \leq 1 \times 10^{-7}$ cm/sec;**
- 2. Plastic liner (geomembrane such as 60 mil HDPE);**
- 3. 1 foot of drainage layer with hydraulic conductivity of $k \geq 1 \times 10^{-2}$ cm/sec ;**
- 4. 1.5 feet of protective cover.**

B. 10-17-2 (a)(2) At the sump area, starting from the subgrade and extending upward:

- 1. 2 feet of compacted soil with hydraulic conductivity of $k \leq 1 \times 10^{-6}$ cm/sec;**
- 2. 1 foot of drainage layer with hydraulic conductivity of $k \geq 10 \times 10^{-2}$ cm/sec;**

"Bathtub" Model of Modern Sanitary Landfill



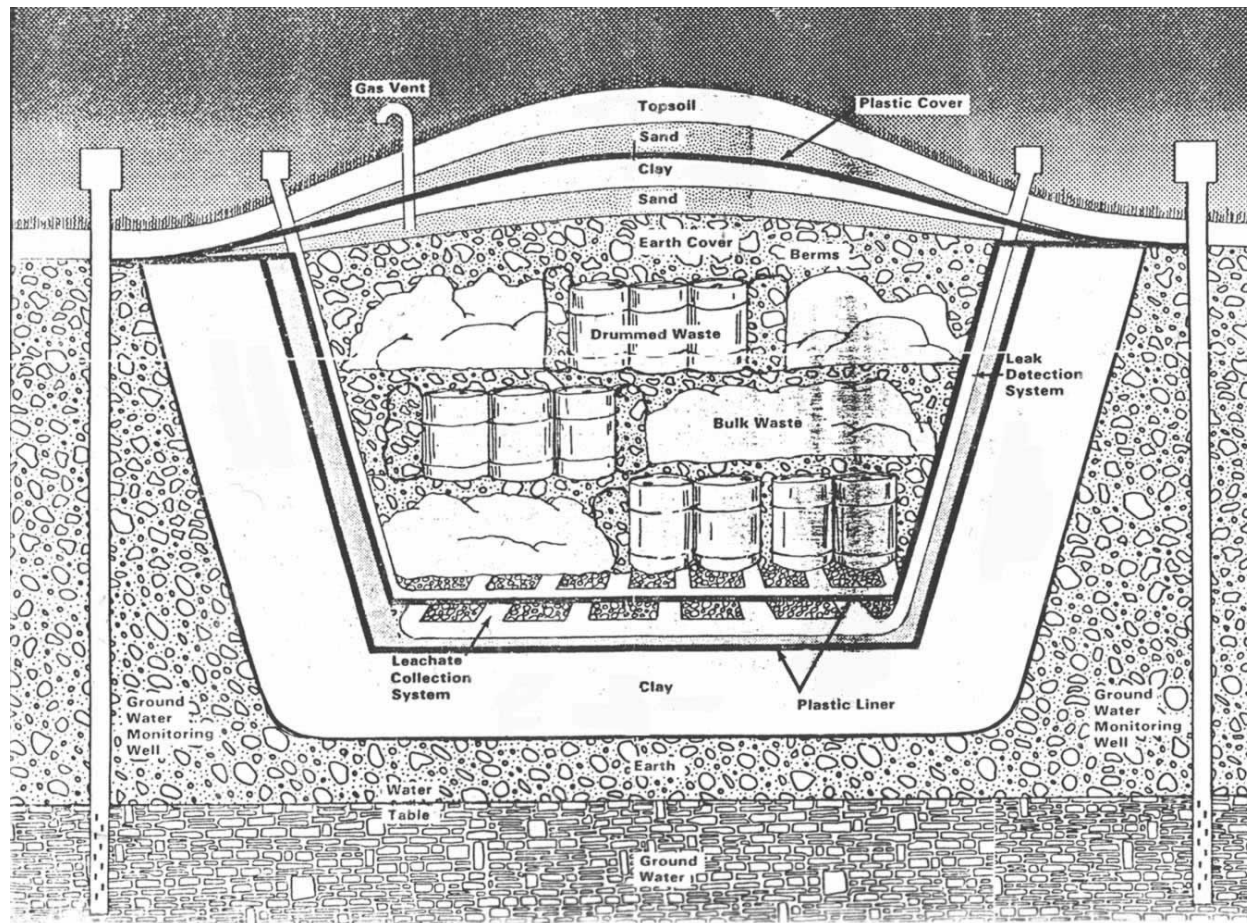
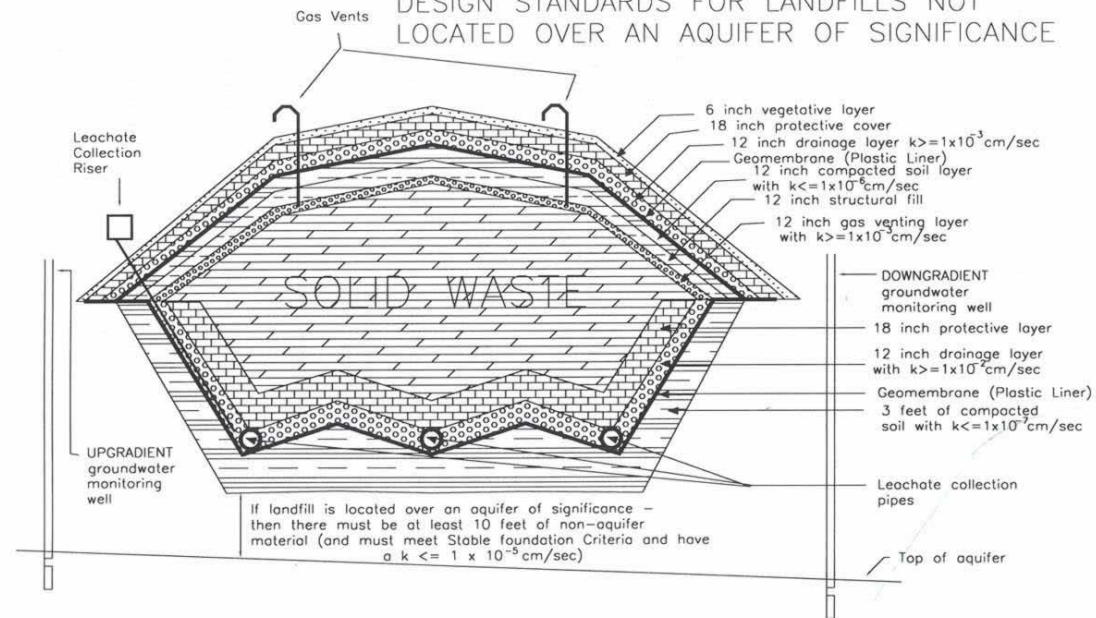
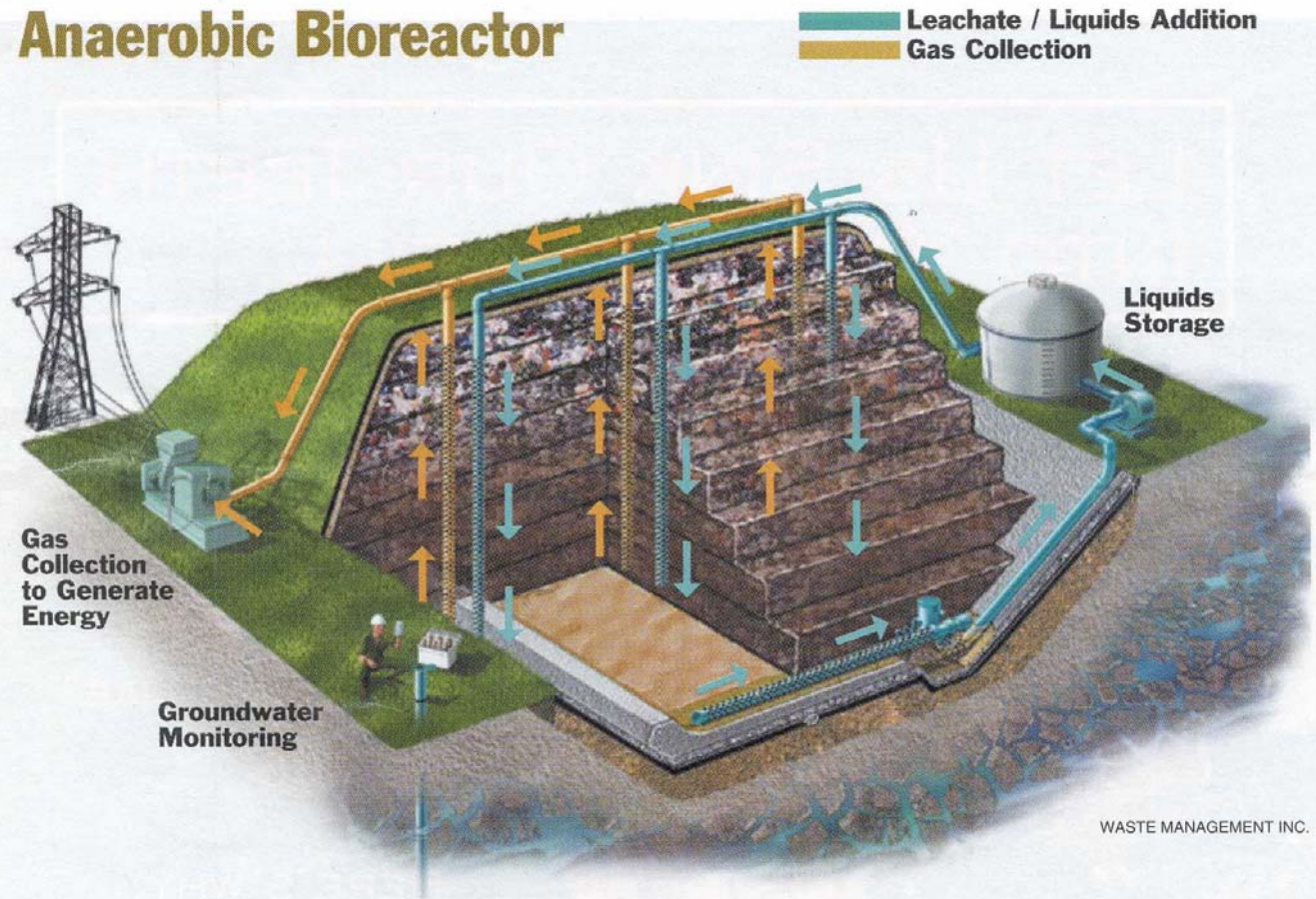


FIGURE 1

DESIGN STANDARDS FOR LANDFILLS NOT
LOCATED OVER AN AQUIFER OF SIGNIFICANCE



Anaerobic Bioreactor



It's a living thing

Landfill technology is changing with the times



THE FOUR LAWS OF ECOLOGY

- 1. Everything is connected
to everything else**
- 2. Everything must go
somewhere**
- 3. Nature knows best**
- 4. There is no such thing
as a free lunch**

CATHY

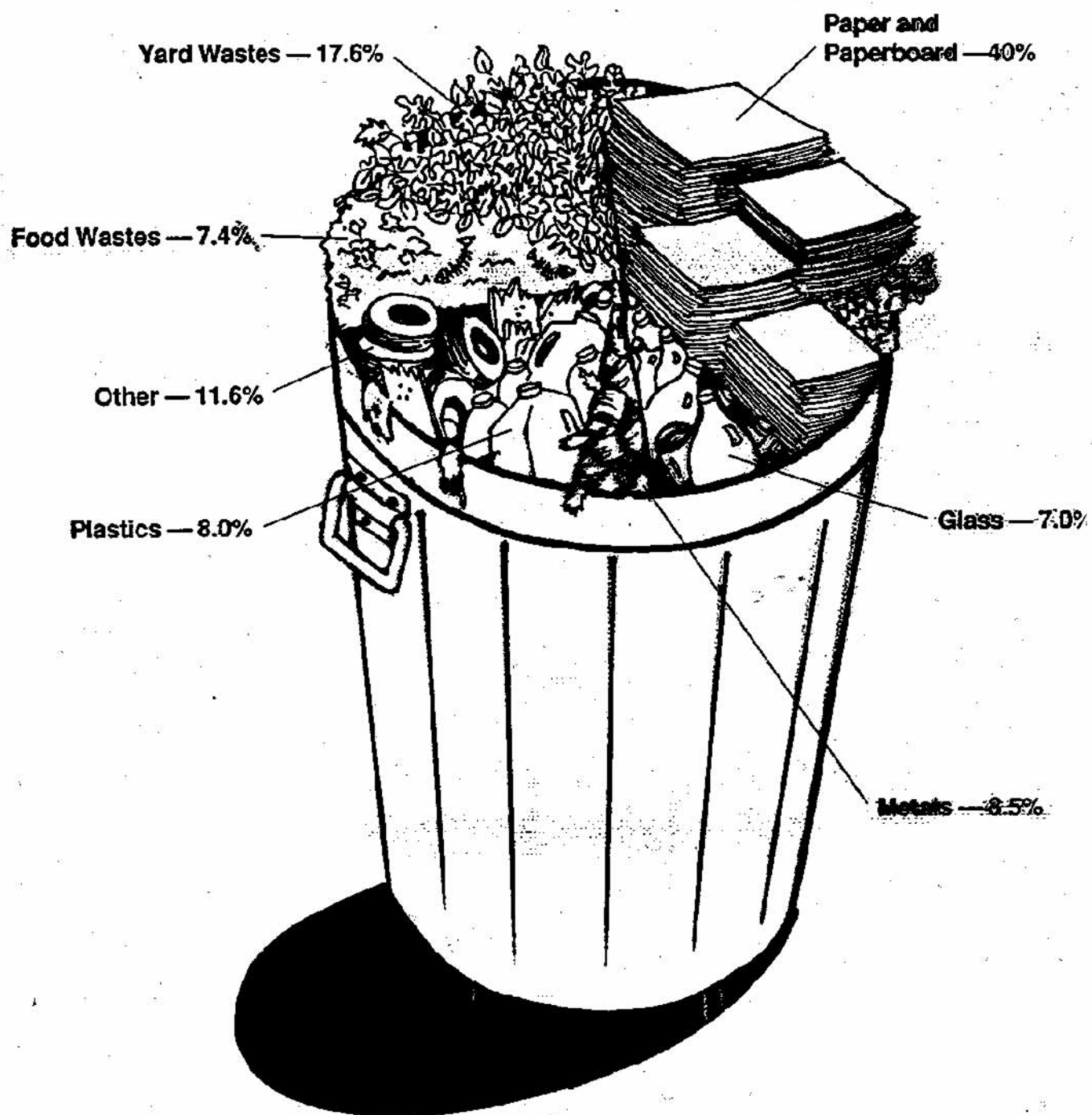


WIZARD OF ID

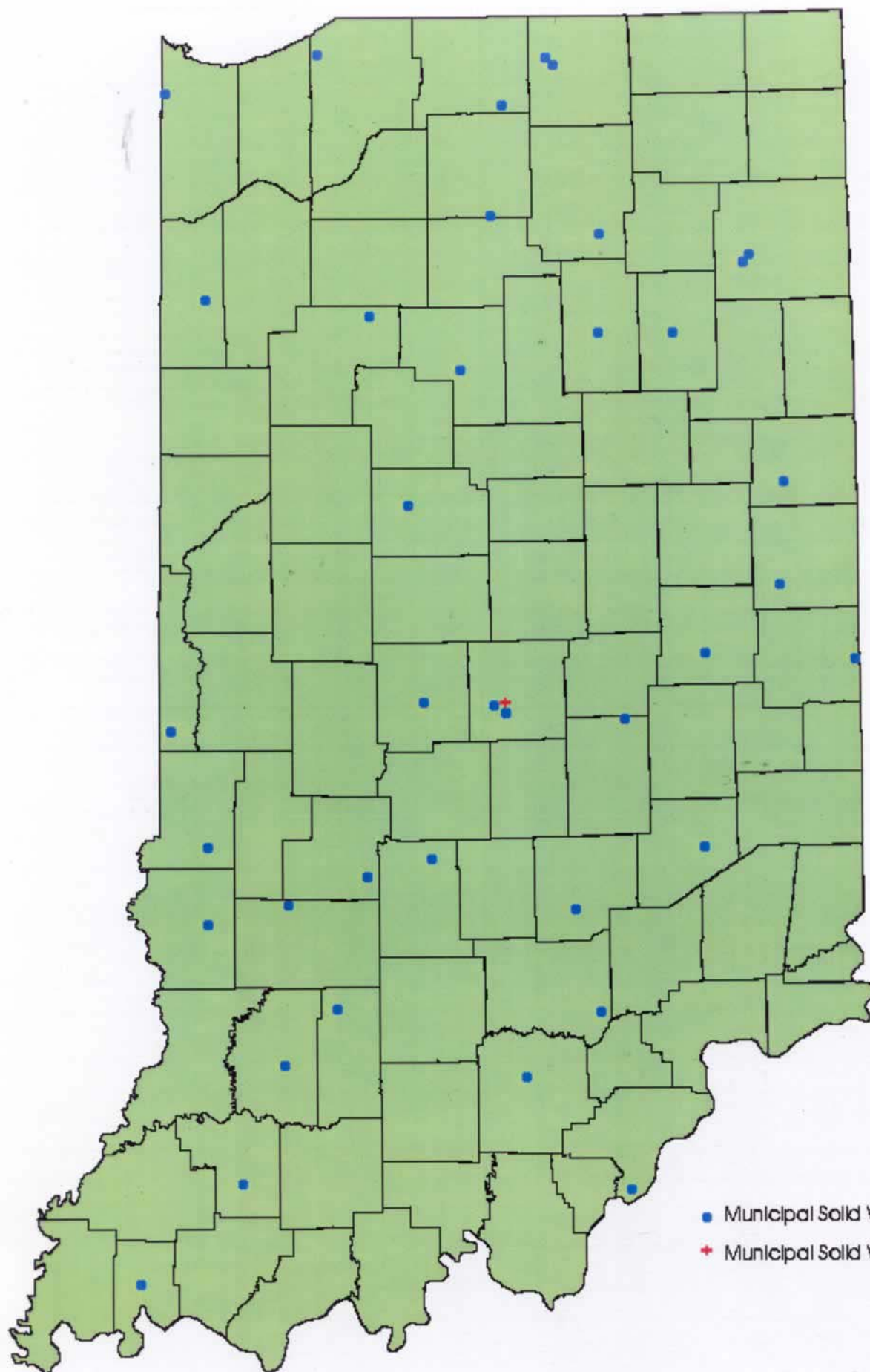
By Brant Parker and Johnny Hart



Materials Discarded into the Municipal Waste Stream*



* Numbers do not add up to 100% due to rounding.



- Municipal Solid Waste Landfills
- + Municipal Solid Waste Incinerator

